

N82 22689

IONOSPHERIC DISTURBANCE OVERVIEW

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The operation of the Satellite Power System (SPS) is currently designed to provide between 5 to 10 gigiwatts of power on a continuing basis to the surface of the earth. At the center of the microwave power beam, the power density is of the same magnitude that could lead to enhanced heating of the ionosphere and to the creation of changes in the structure of the ionosphere. The degree to which the ionosphere and ionospheric-dependent telecommunication systems will be impacted by the operation of the SPS is, therefore, of concern.

A program of research and exploratory development that is national in scope has been undertaken in order to assess the potential impact of SPS operation upon the ionosphere. This program relies upon the utilization of ground-based ionospheric heating facilities in order to simulate the ionospheric heating that will proceed from SPS operation. Facilities located at Platteville, Colorado, and Arecibo, Puerto Rico, form the focus of experiments that have been undertaken in order to simulate observed results and to extrapolate the results to the SPS operational scenario.

Thus far the experimental program directed toward assessing telecommunications impacts due to SPS operation has received the most attention. In August, September, and October 1979, and again in March 1980, the Platteville high-powered, high frequency Facility was operated in a mode that simulates SPS ionospheric heating. Telecommunication systems operating in the VLF, LF, and MF portions of the electromagnetic spectrum were monitored. The performance of OMEGA (VLF), LORAN-C (LF), and AM broadcast (MF) stations was investigated during times when the Facility was "ON" and when it was not. The locations of the radio receivers that provided for the monitoring of the signal characteristics of the systems were chosen in order that the radio energy passed through the ionosphere modified by the Platteville Facility.

Figure 1 shows a typical example of the type of data and results that were observed. Shown on the figure is the phase and amplitude of OMEGA signals transmitted from Hawaii and monitored at Brush, Colorado, on August 16, 1979. The OMEGA-Hawaii signal is transmitted on a frequency of 11.8 kHz. The phase is given in microseconds ( $\mu$ s) and the amplitude is decibels (dB). The hatched areas indicated above the time scale refer to those times that the Facility was operating in the "ON" mode. At all other times the Facility was not modifying the ionosphere.

Close inspection of the figure reveals little change in the behavior of the OMEGA phase and amplitude when the Platteville Facility was "ON" and when it was "OFF". Taking five minute averages of the phase and amplitude when the Facility was "ON" and when it was "OFF" shows that the phase was  $3.82 \pm 1.54 \mu$ s with the Facility "ON" and  $5.82 \pm 1.45 \mu$ s with it "OFF"; the amplitude was  $14.9 \pm 1.30$  dB

with the Facility "ON" and  $15.1 + 0.90$  dB with the Facility "OFF". Data taken on different days and data observed on the LORAN-C and AM broadcast stations show no change in the performance of VLF, LF, and MF systems that can be associated with operation of the Satellite Power System.

The experimental program geared toward assessing the physical phenomenon involved in ionospheric/microwave beam interactions relies heavily upon the Arecibo Facility. It is anticipated that this Facility will be supplying SPS comparable power density to the ionosphere in the near future. Theoretical studies have been directed toward developing predictive models of the ionosphere that include the effects of enhanced electron heating in the D region and thermal self-focusing in the F region.

The SPS Ionospheric Disturbance program involves the expertise of a number of individuals and organizations. The organizations actively participating in the assessment are listed in Table 1. The program is directed toward assessing the degree to which the operation of the SPS will modify the ionosphere and impact upon the performance of telecommunication systems.

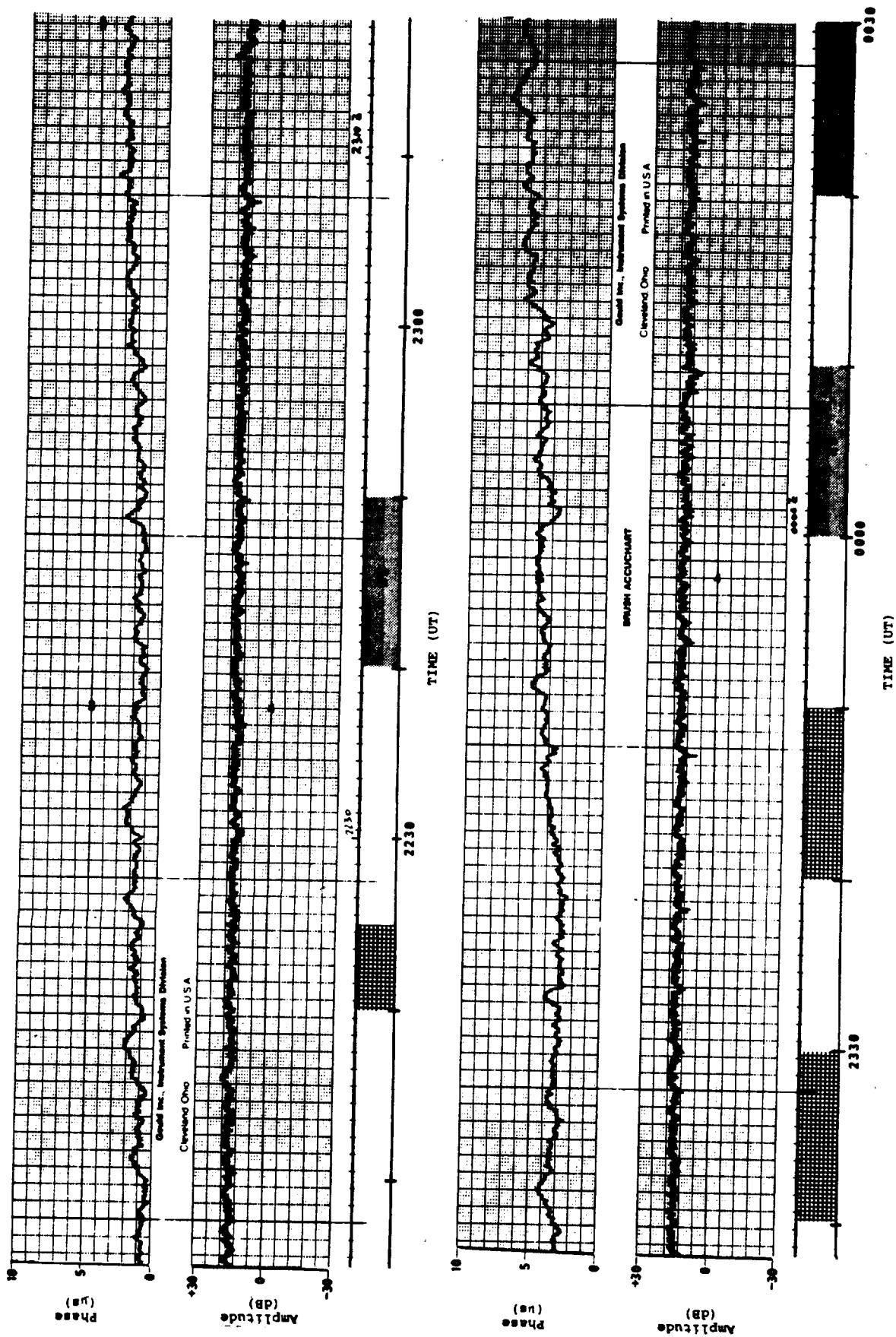


Figure 1. OMEGA phase and amplitude recorded at Brush, CO, from Hawaii  
at 11.8 kHz on August 16, 1979.

Table 1. Participating Organizations in the SPS Assessment  
of Ionospheric Disturbance Effects

<u>Organization</u>	<u>Program Area</u>
Institute for Telecommunication Sciences SRI, International Emmanuel College	Telecommunications Effects
Los Alamos Scientific Laboratories Rice University Case Western Reserve University	Experimental Physics Studies
United Technologies Research Center Plasma Physics Laboratory, Princeton University of Colorado National Center for Atmospheric Research	Theoretical Studies
Raytheon Corporation University of Illinois	Expert Advisors
Institute for Telecommunication Sciences	Overall Program Management